# CHAPTER III.1. INTRODUCTION TO THE COSTS OF DEVELOPMENTAL ILLNESSES AND DISABILITIES

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# CHAPTER III.1. INTRODUCTION TO THE COSTS OF DEVELOPMENTAL ILLNESSES AND DISABILITIES

#### III.1.A Overview

This section of the handbook focuses on developmental illnesses and disabilities that may be associated with exposure to environmental agents. Its chapters (III.2 through III.9) provide data on the direct medical costs of individual effects or groups of similar types of developmental effects. As in previous chapters, information is not included on all elements of willingness to pay (WTP) to avoid the illness. A summary of the cost elements that comprise WTP is provided in Chapter I.1. Due to the availability of data on some additional cost elements in the source used to obtain direct medical costs, data are provided on the additional cost elements at the end of some chapters in this section.. Some of elements for which cost estimates are not available, such as the WTP to avoid pain and suffering in children, are likely to be very substantial in the case of adverse developmental effects.

#### Link to Chapter I.1.

This chapter contains a description of some aspects of the environmental causes of developmental toxicity, types of effects, and general issues related to economic valuation of developmental effects, as well as a list of agents associated with developmental toxicity and genotoxicity.

#### III.1.A.1 Description

Developmental effects cover a wide spectrum of short- and long-term illnesses, disabilities, and conditions. Pre- and postnatal exposure of children carries risks that differ in many respects from those of adults due to the unique physiological characteristics of developing individuals, their food consumption patterns, other exposure characteristics, and other factors (NAS, 1994). For example, children (especially infants) have a much higher food intake than adults in relation to their body weight. They may have much greater contact with soil, and their skin absorption differs from adults.

Developmental illnesses and disabilities may be referred to in some EPA sources as "adverse developmental effects," and are defined in this handbook as any adverse health effect resulting from exposure of the mother or father pre-conception, of the mother during pregnancy, or of a

<sup>&</sup>lt;sup>1</sup> These differences are described in a recent NAS report, developed by pediatricians, epidemiologists, toxicologists, and environmental scientists.

child to toxic substances. Adverse developmental health effects range from physical deformities such as cleft palate, cleft lip, and shortened limbs, to cognitive impairments such as mental retardation, hyperactivity, and delayed cognitive development. Effects also include reduced birth weight, growth retardation, adverse hormonal changes, and abnormalities in physiology (e.g., liver and kidney function) and effects resulting from genetic abnormalities (e.g., Down syndrome).<sup>2</sup>

There are hundreds of developmental effects listed under the general category of congenital anomalies in the International Classification of Diseases (ICD-9-CM).<sup>3</sup> ICD-listed effects include structural abnormalities that result from errors in embryogenesis or the fetal period (Bennett and Plum, 1996) and are usually identifiable at, or shortly after, birth. Synonyms include congenital malformations, birth defects, or structural anomalies (Bennett and Plum, 1996). Other developmental effects include non-structural abnormalities such as physiological disturbances. Still other effects may occur during childhood; for example, lead-induced brain damage can occur up through late adolescence (discussed in Chapter III.9).

Those developmental effects chosen for inclusion in this handbook include illnesses and disabilities that could reasonably be associated with environmental exposures to chemicals and that had sufficient medical cost information to be of use in economic valuations.

Major congenital anomalies, which comprise the majority of developmental effects discussed in this handbook, are identified in two to three percent of all newborn infants, independent of ethnic group or country of origin. Many anomalies are not detected at birth. During the first year of observing the child, as developmental milestones are anticipated, the rate of diagnosis doubles. By school age (five years) approximately five to seven percent of children have been diagnosed with a major congenital anomaly or learning disability (Bennett and Plum, 1996). (Learning disabilities are not included in this edition of the handbook but may be included in the future.)

#### III.1.A.2 Overall Costs

The medical and related costs of developmental effects are substantial. Low birth weight (LBW), which is a relatively common occurrence in the

<sup>&</sup>lt;sup>2</sup> Many of these are referred to as "birth defects" in the popular press, especially physical effects. They fall into the broad categories of structural abnormalities, functional deficiencies, and growth alterations (Kimmel, 1993).

<sup>&</sup>lt;sup>3</sup> Adverse developmental effects, which include all of the types of effects discussed above, are referred to as "developmental effects" subsequently in this chapter, for brevity. The term implies adverse effects, rather than simply any effect that deviates from the norm.

United States, has been estimated to cost approximately 35 percent (\$4 billion) of the \$11 billion spent on health care for infants. Medical care resulting from LBW may cost in excess of one million dollars for a single child (Lewitt et al., 1995). Congenital anomalies, which are a subset of all developmental effects, were estimated to cost \$6.3 billion in 1980 in the United States and represented 1.4 percent of the total cost of illness (Rice et al., 1985). This estimate included direct medical costs and lost productivity, but not special educational costs and developmental services. A similar type of evaluation in 1991 found the national cost of a single effect, cerebral palsy, to be \$1.2 billion. This estimate did not include long-term institutional care, which is often very costly (National Foundation for Brain Research, 1992).

Over one half of children evaluated in subspecialty medical clinics or admitted to hospitals in North America are treated due to disorders arising from congenital anomalies. Two thirds of deaths in pediatric hospitals are also due to these anomalies. In addition, the rate of congenital anomalies in early miscarriages is approximately ten times higher than that observed in infants (Bennett and Plum, 1996). Serious developmental effects are likely to be the cause of pregnancy loss in many cases.

### **III.1.B Causes of Developmental Effects**

The biology of developmental toxicity proceeds by two primary routes: damage to heritable cell lines and damage to somatic cell lines. Heritable cells carry the genetic materials from generation to generation (egg and sperm) and damage typically involves alterations in chromosomes. Genotoxic chemicals cause mutations or death of heritable cell lines and the mutations (genetic changes) may be perpetuated through generations. When cell death occurs, there is no perpetuation of cell lines, whether mutated or not. Somatic cells (non-reproductive cells) may also be damaged by genotoxins or other types of toxins. Somatic cell damage or death affects those cells directly exposed or proceeding from the exposed cells in the same individual (damage is not conveyed from one generation to the next). This section is provided to explain the rationale for including heritable and non-heritable birth defects in the COI handbook. It also provides information on the biological mechanisms behind some birth defects.

<sup>&</sup>lt;sup>4</sup> Genotoxicity deals with the effects of chemicals on DNA and on mechanisms of inheritance in cells and organisms, focusing on the process of mutagenesis (Hoffmann, 1991).

#### III.1.B.1 Somatic Cell Damage

Chemicals may cause cellular toxicity, including toxicity to genetic material. Somatic cell damage affects the exposed individual primarily by altering cell structure or function. Exposure to chemicals that are genotoxic or toxic to the cells in other ways during the prenatal period can cause damage to somatic cell lines during development by altering or killing cells. Exposure thus results in damage to cells, or in the absence of cells that would arise from the damaged cell. Although redundancy occurs in many developing systems and damage does not always lead to birth defects, somatic cell damage from cellular toxicity may be responsible for many of the birth defects discussed in this section. For example, genotoxicity, and other types of cellular toxicity that prevent cell replication, limit the production in the embryo of neurons in the central nervous system (CNS). They also limit the development of limb buds that eventually become limbs and digits, resulting in shortened or absent limbs (discussed in Chapter III.4). Cleft lip or palate (discussed in Chapter III.3), some heart anomalies (discussed in Chapter III.5), and spina bifida (discussed in Chapter III.6) may also result from failure of early cells to form and migrate properly. (There may also be a heritable component to some occurrences of these effects that affects cell replication and movement, as discussed in Section III.1.B.2 below.)

Changes in somatic cells may also affect the offspring of an exposed woman when the cellular damage alters her physiology or reproductive system in such a way that it impacts her children (e.g., via maternal toxicity). For example, a woman whose toxic exposure caused severe kidney damage may not have the necessary capacity in her kidneys to adequately process the substantial increase in fluid load that accompanies pregnancy. Renal failure and the related toxicity to the mother will have a serious and sometimes fatal impact on the child. Generally, when past toxicity to the mother is the cause of an adverse developmental effect, it is not reported in the toxicological literature. This omission occurs because the studies are looking for toxicity in the offspring that is independent of maternal toxicity, and is appropriate from a scientific perspective to evaluate some aspects of developmental toxicity. Information is then lacking, however, that may be appropriate for a benefits assessment on the simultaneous occurrences of maternal and offspring toxicity.

#### III.1.B.2 Heritable Cell Damage

Heritable cells carry the genetic materials from generation to generation (via egg and sperm) and damage typically involves alterations in chromosomes in these cells. Changes in heritable cells may be perpetuated through generations. The mutations include alterations in specific

chromosomes, as well as in the number of chromosomes (e.g., Down syndrome occurs when three of chromosome number 21 are present rather than the usual two chromosomes).

The mutations may be observable in all persons with the chromosomal alteration (dominant disorders), or may be expressed only when two chromosomes (one from each parent) with the same alteration are present (recessive disorders). Consequently, many mutations are not continuously observable because they are recessive, but may appear when both parents have the same recessive mutation (Hoffmann, 1991). Many important areas of the chromosomes have substantial redundancy so that mutations in small portions of the chromosome are compensated for by other portions that carry out the same function and remain intact.

Numerous repair mechanisms operate in cells so that exposure to genotoxins does not necessarily result in permanent damage to cells (Hoffmann, 1991). When a chemical is shown by studies to be genotoxic, however, it has the potential to cause chromosome damage. The specific site of chromosome damage cannot be predicted because chemicals alter the basic structure or mechanisms related to DNA replication. Consequently, damage may occur at any site and the nature of any resulting defect can vary accordingly.

In 1984, the National Academy of Sciences estimated that about 0.3 to 0.4 percent of infants have syndromes associated with chromosomal abnormalities (NAS, 1984). More recently these have been associated with approximately seven to ten percent of stillbirths and infant deaths (Bennett and Plum, 1996). As the human genome is mapped, understanding and identification of genetic defects will increase. Some relatively common effects that are based on genetic changes include Down syndrome (discussed in Chapter III.8), Turner's syndrome, and Klinefelter syndrome. Some genetic diseases that are recessive (e.g., cystic fibrosis, Tay-Sachs, and phenylketonuria) are thought to occur primarily through inheritance rather than new mutations (Hoffmann, 1991).

#### **III.I.B.3 Developmental Toxicity Studies**

Most evidence of developmental toxicity is obtained from human epidemiological studies or animal toxicity studies. The majority of data are obtained from animal studies due to ethical issues and difficulties in conducting large-scale controlled human studies. As discussed above, many developmental effects are not observed until many years after birth; consequently, birth defects are poorly tracked in the population with only a small percentage reported formally (i.e., on birth certificates). Other complicating factors include large variations in exposure, lifestyle, and genetically-determined risks of birth defects within most populations.

Animal studies are often preferred due to the difficulty in conducting human studies and for a variety of other reasons. These reasons include cost, ethical considerations, and the level of control over exposure concentrations and durations. Confounding study factors are limited in an animal study and an evaluation of all observable structural and functional effects is possible. There are many limitations to animal studies, including considerable interspecies differences in neurological capabilities and potential damage, and some physiological differences between study mammals and humans.

Often the implications of effects observed in human and animal studies are not clear from a health or economic perspective. For example, a recent study by Kanitz et al. (1996) found that some water disinfection chemicals were associated with reduced infant head size and body length in some communities (characteristics easily extracted from birth certificates). These features usually suggest retarded development. Although giving clear reason for concern, the immediate and long-term health effects of these measures aren't clear. Such external measures don't provide specific information on the more important internal effects on the brain or other organ systems or on future development. Consequently, the data cannot be easily used to establish the benefits of avoidance, even though most people would agree that a considerable benefit is to be gained from avoiding the observed effects. Some human studies (e.g., of mercury) provide more straightforward indications of developmental toxicity.

Animal studies of developmental toxicity have been carried out for many environmental agents, and are required by the federal government for some groups of chemicals (e.g., as part of the registration process for pesticides and some pharmaceuticals). Although effects seen in humans may be different than those seen in animal studies, it is assumed that developmental effects in animals indicate the potential for developmental toxicity in humans (EPA, 1991). Agents associated with developmental toxicity are listed in Section III.1.D below.

#### III.1.B.4 Genotoxicity

Genotoxicity, as discussed above, may result in mutations or death of somatic or heritable cell lines. Ethical considerations preclude the testing of toxic agents on humans, but data on genotoxicity exist from studies of occupationally-exposed workers. Incidental exposure to some chemicals present in the workplace has been shown to cause chromosomal damage in some workers. For example, exposure to vinyl chloride, styrene, benzene and ethylene oxide have been positively associated with chromosomal aberrations (Hoffmann, 1991). A high incidence of spontaneous abortions was observed in nurses exposed to genotoxic cancer therapy drugs. Even when these studies have been carried out, it is very difficult to

establish unequivocally whether a chemical causes genotoxicity in humans using epidemiological studies, due to a number of factors, including:

- the inability to fully characterize all exposures that may contribute to genotoxicity;
- the likelihood that severe damage will result in early miscarriage and not be observable;
- the largely random occurrence of many birth defects (e.g., Down syndrome); and
- the separation in time between germ-cell mutations and effects in subsequent generations (Hoffmann, 1991).

In addition, damage to cells, whether heritable or somatic, may be followed by cell repair or death, which may not result in an adverse outcome. Multiple factors determine whether an adverse effect at the cellular level will result in damage to a child.

Some studies in animals have been performed. The availability, however, of relatively quick and inexpensive in vitro assays on human or other mammalian cell cultures using somatic and reproductive cells, or on small animals or microorganisms, make these the methods of choice for most genotoxicity tests. In addition, researchers are beginning to study the mutagenicity of environmental mixtures that occur in their natural setting. Hannigan et al. (1996) recently evaluated the mutagenicity of urban particulate air pollution samples. This type of research has the potential to provide very useful information regarding the mutagenic potential of environmental pollutants.

Thousands of chemicals have been evaluated using various in vitro tests of genotoxicity to determine the potential for genotoxic effects.<sup>5</sup> This information has been commonly used as an indicator of a chemical's carcinogenic potential, because there is a link between genotoxicity and cancer (Hoffmann, 1991). This information also has implications for a chemical's potential to cause developmental toxicity. Genotoxicity is not, however, used at this time to establish a *causal* link between developmental effects and exposure. Even when human data are available indicating that an agent causes mutations, it is not possible to predict the type of developmental effect that would arise from the mutation because damage can occur at thousands of sites on the chromosomes.

Agents associated with genotoxicity are listed in Section III.1.D. below.

<sup>&</sup>lt;sup>5</sup> The Environmental Mutagen Information Center in Oak Ridge, Tennessee, had data on 21,000 chemicals in their database in 1990 (Hoffmann, 1991).

#### III.1.B.5 Categories of Causes of Developmental Damage

The contributions to congenital anomalies by various factors have been estimated:

congenital infection	2 - 3%
maternal diabetes	1.5%
other maternal illness	<1.5%
chromosomal	6%
monogenic	7.5%
multifactorial	20%
maternal medication	1 - 2%
unknown	>50%

(Bennett and Plum, 1996)

As this list indicates, most congenital anomalies have no clear origin (more than 50 percent). They may arise from a single factor or a specific combination of factors. Interference with the normal progress of development during a pregnancy may result from genotoxic effects, cellular toxicity, or other factors. Adding to the complexity of evaluating developmental toxicity is the fact that the nature of the developmental effects often depend on the period of development during which exposure occurred.

#### III.1.C Valuation Issues

#### III.1.C.1 Short- Versus Long-term Effects

Developmental effects can be organized in many different ways, and are typically approached by the medical community on an organ system basis (e.g., neural damage, skeletal abnormalities) or by syndrome (e.g., Down). Approaching these effects from an economic perspective may require a different approach that takes into account issues of cost, such as long-versus short-term care. Economic evaluations differ substantially depending on whether effects are time-limited or not. For example, treatment and monitoring for elevated blood-lead levels is usually time-limited, while medical treatment and services for cerebral palsy require long-term medical and other interventions. Most developmental effects required long-term follow-up and care, often including a variety of medical specialities, leading to relatively high lifetime care costs.

Federal and state agencies tend to group many of the effects that require long-term care under the heading of "disabilities." This term includes physical and mental disabilities, which share the common requirement that long-term care is required. Many of the disabilities are classified by the

Department of Health and Human Services and enable families to receive special funding for medical care, maintenance, and other costs incurred by the disabled child and adult. Funding is carried out through programs such as Supplemental Security Income (SSI). The availability of federal databases that track these types of disabilities and costs improves our ability to estimate the treatment patterns and costs.

Fewer data are available for disabilities not covered under federal programs. Care may be received from a variety of specialists and is often difficult to estimate, due to variations in the types of services that are required. There is considerable variation in services and costs among children with the same disabilities, due to differences in the severity of their disabilities. An example of this can be observed among children with Down syndrome, who may range from mildly affected by the chromosomal abnormality to severely incapacitated. With the advent of managed care, there has been an effort to evaluate the overall costs of caring for children with disabilities that do not qualify for government supplements, so that capitation costs can be estimated. This process is still in its infancy, although some data are available that have been developed for this purpose.

#### III.1.C.2 Occurrence of Illnesses

Tracking of occurrence is poor because only a small percentage of developmental effects is reported on birth certificates. Many effects are not noted at birth and may be observable only after a child begins to develop and is observed to miss critical developmental milestones. Severe birth defects are more often reported because they are observed at birth and are typically reported; however, many of these are very rare. (e.g., spina bifida, Down Syndrome) (McManus et al., 1996 in Altman and Reinhardt, Eds., 1996). Their rarity occurs in part because severe impairments often result in miscarriage rather than a live birth. When the occurrence of a disease is infrequent, it is particularly important to access data on large population groups to obtain reasonable estimates of average costs.

Recent work using a large set of California databases has been carried out by Waitzman et al. (1996), used in Chapters III.3 through III.8 in this section and described in Chapter III.3. In addition, the Agency for Toxic Substances and Disease Reduction is funding studies in numerous states that provide training for medical staff and follow-up evaluations for children to better ascertain the actual rates of developmental effects. These efforts are linked to studies of environmental pollutants and developmental effects. A better understanding of the occurrence and causation of developmental effects is expected to result from these studies.

#### III.1.C.3 Multiple Effects

A single chemical often induces an array of effects on different organ systems. The occurrence of multiple effects has been reported in both the human epidemiological and animal toxicological literature. Most animal studies report multiple effects when developmental effects are observed. This observation is supported by the public health literature on children with disabilities, which indicates that disabled children often have multiple disabilities. For example, low birth weight is associated with physical and cognitive disabilities, and with liver, kidney and brain damage (Hacket et al., 1994; see also Chapter III.2). The multiple simultaneous occurrences of effects are reported in the chapters within this section that discuss specific developmental effects. When data were available, the chapters provide information on the likelihood of co-occurrence of effects. The information provided on the costs of developmental effects reflects these complexities. The clustering of effects differs considerably among individuals, however, and introduces uncertainty into the analysis.

The developmental effects of chemicals differ, depending on when exposure occurs, because different components of organs are developing at different stages during a pregnancy and postnatally. For example, development within the CNS occurs over many years, with especially rapid development during early life. Some milestones in the development of the human nervous system are listed below:

#### Prenatal:

neural tube closes	22-26 days
first neurons born	22-26 days
cortical neurons migrate	6 weeks
mesencephelon expands considerably	9 weeks
cerebellum is visible	12 weeks
reflex actions are observable	3 months
most major nerve tracks have been formed	6 - 9 months

#### Postnatal:

cortical migration complete	5 months
neuron proliferation complete	12 months
myelin 50 percent complete	18 months
visual system connections complete	3 - 4 years
brain is mature in form	20 years
•	•

Cell proliferation and neural connections occur continuously during early life, and interference in this process may lead to impaired or altered neural functioning. The CNS is particularly susceptible because it produces many cell types over an extended period and thus is subject to injury at more stages than other organs. It also does not have the ability to replace missing neurons when the developmental period for that neuron is past

(Rodier, 1994). Although the CNS is particularly vulnerable, all organ systems go through many stages during the prenatal period and have varying susceptibilities and manifestation of toxicity during early life.

The effects discussed in this section often occur in multiples, and the costs of concurrent effects are incorporated into the costs for some effects (those discussed in Chapters III.2 through III.8). Generally, however, medical costs are presented for each illness or disability separately (this is discussed in more detail in Chapters III.2 and III.3). Based on the nature of the economic analysis and the supporting scientific data for the chemicals of concern, it may be appropriate to include an illness with its related effects. Inclusion is a matter of judgement. For example, a large percentage of children with Down syndrome have hearing loss and serious visual problems. Inclusion of treatments would be logical, since these conditions are so strongly associated with the syndrome. Alternatively, children with many of the cardiac defects presented in Chapter III.5 often have related cardiovascular problems. These problems are often treated with the predominant effect presented in the chapters, and are part of the costs of both immediate surgical intervention and follow-up care. Consequently, separate calculations of the benefits of avoiding these related effects would not be necessary.

#### III.1.C.4 Prognosis

Developmental diseases and disabilities vary widely in their progression. Some types of anomalies have a relatively good prognosis (e.g., correction of cleft lip and palate), with most patients achieving a normal quality of life. Others, such as Down syndrome patients, have lifelong costs associated with their multiple symptoms and have a shortened lifespan. Some effects, such as very low birth weight are usually fatal. Although generalizations can be made regarding the "average" prognosis for specific effects, the prognosis for survival and the length of time over which treatment is required varies widely among individuals. Consequently, the cost estimates presented in the chapters in this section use estimates of the average treatment and survival rates to obtain representative estimates of the medical costs.

### III.1.D Environmental Agents Associated with Developmental Toxicity

This section contains lists of agents associated with developmental toxicity and genotoxicity. As previous sections discussed, these data have many limitations. Additional information on each chemical may be obtained from the listed source and from a Medline or Toxnet search.

#### **III.1.D.1 Developmental Toxicity Agents**

Table III.1-2 lists many of the chemicals that have evidence of developmental toxicity in animals or humans. Due to the orientation of this handbook toward environmentally-induced illnesses, the discussion focuses on induction by environmental agents. The information in this table was obtained from journal articles, toxicology texts, and study reports submitted to the government by pesticide registrants and other chemical industry sources. The table does NOT provide an exhaustive list of chemicals that cause developmental toxicity, but instead gives an indication of the diversity of chemicals that have been associated with these effects. Information is provided below on genotoxins, which are potential causative agents with a less established but no less important link to adverse developmental effects. (Many chemicals have evidence of both developmental toxicity and genotoxicity.)

TABLE III.1-1. CHEMICALS ASSOCIATED WITH DEVELOPME	NTAL EFFECTS <sup>1</sup>
DATA FROM HUMAN AND ANIMAL STUDIES AF	REFERENCE
*ACETONE	1
*ACROLEIN	3
*ACRYLIC ACID	7
*ACRYLONITRILE	1
*ALACHLOR	4
*ALDICARB	1
AMINOPTERIN	3
*AMITRAZ	1
*AMITROLE	3,5
ANTU	1
*AROCLOR 1016 (A PCB)	7
*ARSENIC COMPOUNDS	3
*ARSENIC	3
ASULAM	7
*ATRAZINE	9
AVERMECTIN B1	7
*BENOMYL	7,1
*BENZENE	5
*BENZO(A)PYRENE	14
BIORESMETHRIN	10
BISULFAN	14
BORIC ACID	3
BRADIFACOUM	3,4
BUSULFAN	3
BUTACHLOR	1
*CADMIUM	14
CAPROLACTAM	7
CAPTAFAL	6
*CAPTAN	7,1,2
*CARBARYL	1,2,5
*CARBOFURAN	1
*CARBON TETRACHLORIDE	5

CHEMICAL         REFERENCE           CARBON DISULFIDE         5,7           CARBON DISULFIDE         5,7           CARDON DELOTION         6           CHLORDECONE         11           CHLORDECONE         11           CHLORDERENTS         6           CHLORDERENTS         5           CHLORDERENTS (INCLUDES PCB'S)         3           CHLOROPHENYLS (INCLUDES PCB'S)         3           CHLOROPHENYLS (INCLUDES PCB'S)         5           CHLOROPHAGINONE         1           CHLOROPHAGINONE         1           CHLOROPHAGINONE         1           CHLOROPHADONIL         4           CHLOROPHADONIL         4           CHLOROPHAD         1           CHLOROPHAD         1           CHLOROPHAD         1           CHLOROPPOPHAM         1           CHLOROPPOPHAM         1           CHLOROPPOPHAM         1           CHLOROPPOPHAM         1           CHLOROPPOPHAM         1           COMMACHUR         1           COMMACHUR         1           COMACHUR         1           COMACHUR         1           COLORATERAL         3	DATA FROM HUMAN AND ANIMAL STUDIES ARE INCLUDED.	
CARBOPHENOTHION   6   6		REFERENCE
12		
CHLORDECONE		
CHLOREMETORM         6           CHLORNEWINPOS         6           CHLORNEGUAT         5           **CHLOROBENZILATE         7           **CHLOROFIENYLS (INCLIDES PCB'S)         3           **CHLOROFORM         5           **CHLOROPHANIN         5           **CHLOROPHENDXY HERBICIDES         15           **CHLOROPHENDXY HERBICIDES         15           **CHLOROPHENDAM         7           **CHLOROPHAM         1           **CHLOROPHAM         1           **CHLOROPHAM         17           ***CHLOROPHAM         1           ***COUMACHLOR         1           ***COUMACHLOR         1           ***CYRADIS         3           ***CYCLOHEXAND         1           ***CYCLOHEXAND         8           ***CYCLOHEXAND         8     <		12
CHLORREQUAT         6           CHLORNEQUAT         5           **CHLOROBIPHENYLS (INCLUDES PCBYS)         3           **CHLOROBIPHENYLS (INCLUDES PCBYS)         3           **CHLOROPHACINONE         1           **CHLOROPHACINONE         1           **CHLOROPHACINONE         1           **CHLOROPHACINONE         1           **CHLOROPHACINONE         1           **CHLOROPHALONIL         4           **CHLOROPHALONIL         4           **CHLOROPHALONIL         1           **CHLOROPHALONIL         1           **CHLOROPHALONIL         4           **CHLOROPHALONIL         4           **CHLOROPHAMIDH         1           **CHLOROPHAMIDH         1           **COPER SULFATE         5           **COUMACHILOR         1           **COUMACHILOR         1           **COUMACHILOR         1           **COUMACHILOR         3           **CYCLOHEXANE         3           **CYCLOHEXANE         1           **CYCLOHEXANOE         3           **CYCLOHEXANOE         5           **CYCLOHEXANOE         1           **CYCLOHEXANOE         1           **CYC		
CHLORMEQUAT   5   5   CHLOROBENZILATE   7   7   CHLOROBENZILATE   7   7   CHLOROBENZILATE   7   7   CHLOROBENZILATE   7   3   3   CHLOROFORM   5   5   1   1   1   1   1   1   1   1		
CHLOROBENZILATE		
C-CHLOROBIPHENYLS (INCLUDES PCB'S)   3	CHLORMEQUAT	
CHLOROFORM	*CHLOROBENZILATE	
CHLOROPHACINONE         1           CHLOROPHENOXY HERBICIDES         15           CHLOROPROPHAM         7           'CHLOROPTHALONIL         4           CHLOROPROPHAM         1           'CHCROPROPHAM         1           'CHROMIUM         17           'COPPER SULFATE         5           COUMACHLOR         1           COUMAFURYL         3,4           COUMAFURYL         3,4           COVALORES         3           "CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXANONE         8           CYCLOHEXIMIDE         5           CYCLOHEXIMIDE         14,3           "CYHALOTHRIN         7           "2,4-D         4,6           DALAPON         1           DECAMETRIN         9           DECAMETRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI[2-ETHYL HEXYL] ADIPATE         7           "DIBROMOCHLOROPROPANE         5           "DICHLOROBENIZENE         1           "DICHLOROBENIZENE         1           "P-DICHLOROBENZENE         1 <t< td=""><td></td><td></td></t<>		
CHLOROPHENOXY HERBICIDES         15           CHLOROPROPHAM         7           YCHLOROTHALONIL         4           CHLORPROPHAM         1           **CHROMIUM         17           **COPPER SULFATE         5           COUMACHLOR         1           COUMAFURYL         3,4           COUMAFURYL         3,4           **CYANIDES         3           **CYCLOHEXANE         1           CYCLOHEXANE         1           **CYCLOHEXANIDE         5           **CYCLOHEXIMIDE         5           **CYCLOHEXIMIDE         14,3           **CYHALOTHRIN         7           **2,4-D         4,6           DALAPON         1           DEET (DIETHYLTOLUAMIDE)         9           DEP         2           DEP         2           DIC2-ETHYL HEXYL) ADIPATE         7           **DIBROMOCHLOROPROPANE         5           **DICAMBA         7           DICHLOBENIL         4           **O-DICHLOROBENZENE         1           **DICHLOROBENZENE         1           **DICHLOROPOS         1           **DICHLOROPOS         1           **DI	*CHLOROFORM	5
CHLOROPROPHAM         7           "CHLOROTHALONIL         4           CHLORPROPHAM         1           "CHROMIUM         17           "COPPER SULFATE         5           COUMACHLOR         1           COUMAFURYL         3,4           COUMAFURYL         3,4           COUMAFURYL         3,4           COVALORES         3           "CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXANONE         5           CYCLOPHOSPHAMIDE         14,3           "CYTALOTHRIN         7           "2.4-D         4,6           DALAPON         1           DEET (DIETHYLTOLUAMIDE)         9           DEET (DIETHYLTOLUAMIDE)         9           DEET (DIETHYLADIPATE         7           "DIBROMOCHOROPROPANE         5           "DICHLOBENIL         4           "O-DICHLOBENIZENE         1           "P-DICHLOROBENZENE         1           "P-DICHLOROBENZENE         1           "DICHLOROS         1           "DIFENACOUM         3,4           "DIFENACOUM         3,4           "DIETHYLSTILBESTROL (DES)         1		1
"CHLOROTHALONIL         4           CHLORPROPHAM         1           "CHROMIUM         17           "COPPER SULFATE         5           COUMACHLOR         1           COUMACHY         3,4           COUMATETRALYL         3,4           "CYANIDES         3           "CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXANONE         5           CYCLOHOSPHAMIDE         5           CYCLOHOSPHAMIDE         14,3           "CYHALOTHRIN         7           "2,4-D         4,6           DALAPON         1           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DICZETHYL HEXYL) ADIPATE         7           "DIBROMOCHLOROBENZENE         5           "DICAMBA         7           DICHLOBENIL         4           "O-DICHLOROBENZENE         1           "P-DICHLOROBENZENE         1           "P-DICHLOROPENE (2,3 ON TRI)         1           "DIFENACOUM         3,14           DIFENACOUM         3,4           "DIMETHYL STILBESTROL (DES)         1           DIFENACOUM         3,5 <tr< td=""><td>CHLOROPHENOXY HERBICIDES</td><td>15</td></tr<>	CHLOROPHENOXY HERBICIDES	15
CHLORPROPHAM	CHLOROPROPHAM	7
*CHROMIUM         17           *COPPER SULFATE         5           COUMACHUOR         1           COUMAFURYL         3,4           COUMATETRALYL         3,4           *CYANDES         3           *CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOPHOSPHAMIDE         14,3           *CYCLOPHOSPHAMIDE         14,3           *CYCHALOTHRIN         7           *2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICALOR         4           *O-DICHLOROBENZENE         1           *DICHLOROBENZENE         1           *DICHLOROBENZENE         1           *DICHLOROROPENE (2,3 ON TRI)         1           *DIETHYLSTLBESTROL (DES)         3,14           *DIETHYLSTLBESTROL (DES)         3,14           *DIETHYLSTLBESTROL (DES)         3,5           DIMOSEB         14,7           *DIOXANE         1           DIPHACINONE <t< td=""><td>*CHLOROTHALONIL</td><td>4</td></t<>	*CHLOROTHALONIL	4
*COPPER SULFATE         5           COUMACHLOR         1           COUMACHLOR         3,4           COUMACHURY         3,4           COUMATETRALYL         3,4           *CYANIDES         3           *CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXMIDE         5           CYCLOPHOSPHAMIDE         14,3           *CYCHALOTHRIN         7           *2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DECAMETHRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICHLORBENIL         4           *O-DICHLOROBENZENE         1           *DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           *DICHLOROBENZENE         1           *DICHLOROFITYLE ETHER         1           *1,3-DICHLOROFOPENEE         1           *10EHVLSTILLESTROL (DES)         3,14           *DIETHYLSTILLESTROL (DES)         3,5           DIMETHYLSTILLESTROL (DES) <td>CHLORPROPHAM</td> <td>1</td>	CHLORPROPHAM	1
COUMACHLOR         1           COUMATETRALYL         3,4           COUMATETRALYL         3,4           "CYMIDES         3           "CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXMIDE         5           CYCLOPHOSPHAMIDE         14,3           "CYHALOTHRIN         7           "2,4-D         4,6           DALAPON         1           DEET (DIETHYLTOLUAMIDE)         9           DEFT (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           **DICAMBA         7           DICHLOROPROPANE         5           **DICAMBA         7           DICHLOROBENZENE         1           **DICHLOROBENZENE         1           **DICHLOROBENZENE         1           **DICHLOROPROPENE (2,3 ON TRI)         1           **DIETHYLSTILBESTROL (DES)         3,14           **DIETHYLSTILBESTROL (DES)         3,5           DIMETHYLSTULFOXIDE         3,5           DIMETHYLSTULFOXIDE         3,5           DIMETHYLSULFOXIDE         3,5           DIOXIN         2           DIDOXIN	*CHROMIUM	17
COUMAFURYL       3,4         COUMATETRALYL       3,4         *CYANIDES       3         *CYCLOHEXANE       1         CYCLOHEXANONE       8         CYCLOHEXMIDE       5         CYCLOPHOSPHAMIDE       14,3         *CYCLOPHOSPHAMIDE       7         *2,4-D       4,6         DALAPON       1         DECAMETHRIN       9         DEET (DIETHYLTOLUAMIDE)       9         DFP       2         DI(2-ETHYL HEXYL) ADIPATE       7         **DICAMBA       7         **DICHLOROPROPANE       5         **DICAMBA       7         **DICHLOROBENZENE       1         **DICHLOROBENZENE       1         **DICHLOROBENZENE       1         **DICHLOROPENE (2,3 ON TRI)       1         **DICHLOROPENE (2,3 ON TRI)       1         **DICHLOROPENE       3,14         DIETHYLL SULFOXIDE       3,5         DIMETHYL SULFOXIDE       3,5         DIMETHYL SULFOXIDE       3,5         DIMETHYL SULFOXIDE       3,5         DIOXIN       2         DIOXIN       2         DIPHAGINONE       3,4         DIPHENY	*COPPER SULFATE	5
COUMATETRALYL       3,4         "CYZNIDES       3         "CYZLOHEXANE       1         CYCLOHEXANONE       8         CYCLOHEXIMIDE       5         CYCLOHADIDE       14,3         "CYCHALOTHRIN       7         "2,4-D       4,6         DALAPON       1         DECAMETHRIN       9         DEET (DIETHYLTOLUAMIDE)       9         DFP       2         DI(2-ETHYL HEXYL) ADIPATE       7         "DIBROMOCHLOROPROPANE       5         "DICAMBA       7         DICHLOBENIL       4         "O-DICHLOROBENZENE       1         "P-DICHLOROBENZENE       1         "P-DICHLOROPENE (2,3 ON TRI)       1         DICHLOROVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIEFNACOUM       3,4         "DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DIMETHYL SULFOXIDE       3,5         DIOXIN       2         DIOXIN       2         DIONAN       3         DIOXIN       3         DIOUAT       4         DIOURON       5	COUMACHLOR	1
*CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXIMIDE         5           CYCLOPHOSPHAMIDE         14,3           *CYCLOPHOSPHAMIDE         14,3           *CYCLOPHOSPHAMIDE         7           *2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICHLOROPROPANE         5           *DICHLOROBENZENE         1           *DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           *DICHLOROFTHYL ETHER         1           *1,3-DICHLOROFOPENE (2,3 ON TRI)         1           *DICHLOROFOPENE (2,3 ON TRI)         1           *DICHLOROS         1           *DIFTHYLSTILBESTROL (DES)         3,14           *DIFFANCOUM         3,4           *DIMETHYL SULFOXIDE         3,5           DIMOSEB         14,7           *DIOXIN         2           DIPHACINONE         3,4           <	COUMAFURYL	3,4
*CYCLOHEXANE         1           CYCLOHEXANONE         8           CYCLOHEXIMIDE         5           CYCLOPHOSPHAMIDE         14,3           *CYHALOTHRIN         7           *2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICHAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           *DICHLOROCETHYL ETHER         1           *DICHLOROROPENE (2,3 ON TRI)         1           *DICHLOROON         3,14           DIETHYLSTILBESTROL (DES)         3,14           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHACINONE         3,4<	COUMATETRALYL	3,4
CYCLOHEXMIDE         5           CYCLOPHOSPHAMIDE         14,3           "CYHALOTHRIN         7           "2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           "DIBROMOCHLOROPROPANE         5           "DICAMBA         7           DICHLOROBENIL         4           "O-DICHLOROBENZENE         1           "P-DICHLOROBENZENE         1           DICHLOROFORTHYL ETHER         1           1,3-DICHLOROPENE (2,3 ON TRI)         1           "DICHLOROS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           "DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6	*CYANIDES	3
CYCLOPHOSPHAMIDE         5           CYCLOPHOSPHAMIDE         14,3           "CYCHALOTHRIN         7           "2,4-D         4,6           DALAPON         1           DECAMETHRIN         9           DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           "DIBROMOCHLOROPROPANE         5           "DICAMBA         7           DICHLOBENIL         4           "O-DICHLOROBENZENE         1           "P-DICHLOROBENZENE         1           DICHLOROSENZENE         1           DICHLOROSPENE (2,3 ON TRI)         1           DICHLOROSPENE (2,3 ON TRI)         1           "DICHLOROSO         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           "DIMETHOATE         5,6           DIMOSEB         14,7           "DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6	*CYCLOHEXANE	1
CYCLOPHOSPHAMIDE       14,3         "CYHALOTHRIN       7         "2,4-D       4,6         DALAPON       1         DECAMETHRIN       9         DEET (DIETHYLTOLUAMIDE)       9         DFP       2         DI(2-ETHYL HEXYL) ADIPATE       7         "DIGNOMOCHLOROPROPANE       5         "DICHLOROPROPANE       5         "DICHLOROBENIL       4         "O-DICHLOROBEZENE       1         "P-DICHLOROBENZENE       1         DICHLOROETHYL ETHER       1         1,3-DICHLOROROPENE (2,3 ON TRI)       1         "DIETHYLSTILBESTROL (DES)       3,14         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         "DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         "DIOXIN       2         DIPHACINONE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6	CYCLOHEXANONE	8
*CYHALOTHRIN       7         *2,4-D       4,6         DALAPON       1         DECAMETHRIN       9         DEET (DIETHYLTOLUAMIDE)       9         DFP       2         DI(2-ETHYL HEXYL) ADIPATE       7         *DIGNOMOCHLOROPROPANE       5         *DICAMBA       7         DICHLOBENIL       4         *O-DICHLOROBENZENE       1         *P-DICHLOROBENZENE       1         DICHLOROSENZENE       1         DICHLOROROPENE (2,3 ON TRI)       1         *DICHLOROPOROPENE (2,3 ON TRI)       1         *DICHLOROS       1         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXIN       2         DIPHACINONE       1         DIOXIN       2         DIPHACINONE       3,4         DIQUAT       4         DIURON       5	CYCLOHEXIMIDE	5
*2,4-D       4,6         DALAPON       1         DECAMETHRIN       9         DEET (DIETHYLTOLUAMIDE)       9         DFP       2         DIF       7         **DISTANDAME       7         **DIBROMOCHLOROPROPANE       5         **DICAMBA       7         DICHLOBENIL       4         **O-DICHLOROBENZENE       1         **P-DICHLOROBENZENE       1         **DICHLOROBENZENE       1         **DICHLOROFTHYL ETHER       1         **1,3-DICHLOROROPENE (2,3 ON TRI)       1         **DICHLORVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXIN       2         DIPHACINONE       1         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6	CYCLOPHOSPHAMIDE	14,3
DALAPON         1           DECAMETHRIN         9           DEFT (DIETHYLTOLUAMIDE)         9           DFP         2           DICP         2           DICJETHYL HEXYL) ADIPATE         7           *DIROMOCHLOROPROPANE         5           *DICAMBA         7           DICHLOROBENIL         4           *O-DICHLOROBENZENE         1           DICHLOROBENZENE         1           DICHLOROCETHYL ETHER         1           *DICHLOROROPENE (2,3 ON TRI)         1           *DICHLOROS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	*CYHALOTHRIN	7
DECAMETHRIN         9           DEFT (DIETHYLTOLUAMIDE)         9           DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           *DICHLOROROPENE (2,3 ON TRI)         1           *DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	*2,4-D	4,6
DEET (DIETHYLTOLUAMIDE)         9           DFP         2           DICZ-ETHYL HEXYL) ADIPATE         7           **DIBROMOCHLOROPROPANE         5           **DICAMBA         7           DICHLOBENIL         4           **O-DICHLOROBENZENE         1           **P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           **DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           **DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           **DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	DALAPON	1
DFP         2           DI(2-ETHYL HEXYL) ADIPATE         7           *DIBROMOCHLOROPROPANE         5           *DICAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROTHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	DECAMETHRIN	9
DI(2-ETHYL HEXYL) ADIPATE         7           *DIRROMOCHLOROPROPANE         5           *DICAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6	DEET (DIETHYLTOLUAMIDE)	9
*DIBROMOCHLOROPROPANE         5           *DICAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6	DFP	2
*DICAMBA         7           DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	DI(2-ETHYL HEXYL) ADIPATE	7
DICHLOBENIL         4           *O-DICHLOROBENZENE         1           *P-DICHLOROBENZENE         1           DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	*DIBROMOCHLOROPROPANE	5
*O-DICHLOROBENZENE       1         *P-DICHLOROBENZENE       1         DICHLOROETHYL ETHER       1         1,3-DICHLOROROPENE (2,3 ON TRI)       1         *DICHLORVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	*DICAMBA	7
*P-DICHLOROBENZENE       1         DICHLOROETHYL ETHER       1         1,3-DICHLOROROPENE (2,3 ON TRI)       1         *DICHLORVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	DICHLOBENIL	4
DICHLOROETHYL ETHER         1           1,3-DICHLOROROPENE (2,3 ON TRI)         1           *DICHLORVOS         1           DIETHYLSTILBESTROL (DES)         3,14           DIFENACOUM         3,4           *DIMETHOATE         5,6           DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	*O-DICHLOROBENZENE	1
1,3-DICHLOROROPENE (2,3 ON TRI)       1         *DICHLORVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	*P-DICHLOROBENZENE	1
*DICHLORVOS       1         DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	DICHLOROETHYL ETHER	1
DIETHYLSTILBESTROL (DES)       3,14         DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	1,3-DICHLOROROPENE (2,3 ON TRI)	1
DIFENACOUM       3,4         *DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	*DICHLORVOS	1
*DIMETHOATE       5,6         DIMETHYL SULFOXIDE       3,5         DINOSEB       14,7         *DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5	DIETHYLSTILBESTROL (DES)	3,14
DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5	DIFENACOUM	3,4
DIMETHYL SULFOXIDE         3,5           DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5		5,6
DINOSEB         14,7           *DIOXANE         1           DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5		·
*DIOXANE       1         DIOXIN       2         DIPHACINONE       3,4         DIPHENYLHYDANTOIN       3         DIQUAT       4         DISULFOTON       6         *DIURON       5		
DIOXIN         2           DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5		
DIPHACINONE         3,4           DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5		
DIPHENYLHYDANTOIN         3           DIQUAT         4           DISULFOTON         6           *DIURON         5		
DIQUAT 4 DISULFOTON 6 *DIURON 5		
DISULFOTON 6 *DIURON 5		
*DIURON 5		

DATA FROM HUMAN AND ANIMAL STUDIES ARE INCLUDED.	
CHEMICAL	REFERENCE
*EPICHLOROHYDRIN	5
EPN	6
*EPTC	7
ETHANOL	14
ETHYL CHLORIDE	7
*ETHYL BENZENE	7
ETHYLENE DIBROMIDE	5,6
*ETHYLENE DICHLORIDE	1
*ETHYLENE THIOUREA	14
*ETHYLENE OXIDE	5
ETHYLNITROSUREA	3
EUGENAL	1
*FENBUTATIN OXIDE	4,6
*FERBAM	5
*FLUOMETURON	1
FLURPRIMIDOL	7
FLUTOLANIL	7
*FOLPET	9,3,6
*FORMALDEHYDE	5
GLYCEROL FORMAL	5
GLYPHOSATE	7
HALOXYFOP METHYL	7
*HEXACHLOROBENZENE	5
*HEXACHLOROPHENE	5
*LEAD	14
*LINDANE	6
*LINURON	4,6
*LITHIUM (TRI LISTED AS LITHIUM CARBONATE)	3
*MALATHION	5
*MALEIC HYDRAZIDE	10
*MANEB	1
*MANGANESE	16
*MCPA (METHOXONE)	4,6
*MERCURY	7
METALDEHYDE	5
METHIDATHION	5
METHIBATHION	3
METHOMYL	1
*METHOXYCHLOR	5,7
*METHYL ETHYL KETONE (MEK)	7
METHYL BROMIDE	6
*METHYL METHACRYLATE	3,5
METHYLCHOLANTHRENE	14
METHYLENE CHLORIDE	5
METOLACHLOR	4,7
MEXACARBATE	1
MIREX	14
MNNG	3
*MOLINATE	9
*NABAM	5
*NAPHTHALENES	9
NAPROPAMIDE	7
*NICOTINES	8

DATA FROM HUMAN AND ANIMAL STUDIES ARE INCLUDED.	
CHEMICAL	REFERENCE
*NITRATE	7
NITRITE	7
*NITROFEN	4
NITROGUANIDINE	7
*OXYFLUORFEN	1
*PARAQUAT	8
*PARATHION	5,2
*PCBS	2
PENTACHLORONITROBENZENE	10,9,6,5
*PENTACHLOROPHENOL	5
*PERCHLOROETHYLENE	5
*PERMETHRIN	6
PHENMEDIPHAM	1
*PHENOL	7,1
*O-PHENYLPHENOL	5
PHOSMET	6
*PICLORAM	5
PIDRIN	7
PINDONE	3,4
*PIPERONYL BUTOXIDE	5
PIRIMICARB	4,6
PIRIMIPHOS-ETHYL	6
*PIRIMIPHOS-METHYL	1
2-PIVALYL-1,3 INDANDIONE	3,4
*PROPACHLOR	1
*PROPARGITE	7,6
PROPHAM	1
*PROPOXUR	1,9
*PROPYLENE OXIDE	1
PROPYLENE DICHLORIDE	1
PYRAZON	5
*PYRIDINE	8
RADIONUCLIDES (ALPHA, BETA, & GAMMA EMITTERS)	3
*RESMETHRIN	7
RONNEL	5
ROTENONE	9,7
	1
SODIUM CHLORATE *STRYCHNINE	1
SULFUR DIOXIDE	
	5 4
2,4,5-T	14
TCDD	
2,4,5-TP **TETPACHI OPVINDHOS	6
*TETRACHLORVINIPHOS	6
THERAM	3
THERAM **THARFAIDA ZOLE	2
*THIABENDAZOLE	5
*THIOPHANATE-METHYL 6	1
*THIRAM	5
*TOLUENE	5
*TOXAPHENE	6
*TRICHLORFON	6
*1,2,4-TRICHLOROBENZENE	7
*1,1,1-TRICHLOROETHANE	5

DATA FROM HUMAN AND ANIMAL STUDIES ARE INCLUDED.

DATATIONITIONIAN AND ANIMAL STODIES ARE INCEODED.	
CHEMICAL	REFERENCE
*TRICHLOROETHYLENE	5
TRIDIPHANE	7
*TRIFLURALIN	4,6
*TRIFORINE	4
TRIMETHADONE	3
*URETHANE	14
VALPROIC ACID	3
VERNAM	7
*WARFARIN	3,4
*WHITE PHOSPHORUS	7
*XYLENE	5
*ZINEB	3,6
ZIRAM	9.10

<sup>\* =</sup> Listed in TRI. When "compounds" of a metal were listed on TRI, all compounds of that metal in this table are considered to be TRI chemicals.

#### **Footnotes:**

1. This includes a wide range of effects including skeletal deformities (increased or reduced number of digits or ribs, limb shortening or malformation, spina bifida, cleft lip or palate, etc), neurological impairment (altered cognitive functioning, learning disorders including retardation, palsy, inappropriate responses to stimuli, etc), and structural or functional changes in organs (cardiomyopathy, renal agenesis, sterility, etc).

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- 1. Cunningham and Hallenbeck (1985).
- 2. Stellman, J.M. (1983).
- 3. Doull et al. (1980).
- 4. U.S. EPA (1983a).
- 5. U.S. Department of Health and Human Services, NIOSH (1983a).
- 6. U.S. EPA (1983b).
- 7. IRIS, EPA online database.
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- 13. Chambers and Yarbrough (1982).
- 14. Key et al. (1977).
- 15. Garry et al. (1996).
- 16. Webster and Valois (1987).
- 17. ATSDR (1993).

### **III.1.D.2 Genotoxic Agents**

Table III.1-2 lists agents for which there is evidence of genotoxicity. The evidence varies for each agent and is based on a variety of in vitro and/or in vivo analyses.<sup>6</sup>

TABLE III.1-2. CHEMICALS ASSOCIATED WITH GENOT	OXIC EFFECTS
DATA FROM HUMAN, ANIMAL, AND IN VITRO STUDIES A	ARE INCLUDED.
CHEMICAL	REFERENCES
*ACETONE	5
*ACROLEIN	4
*ACRYLIC ACID	7
*ACRYLONITRILE	5
*ALACHLOR	1
*ALDICARB	1
AMINOPTERIN	3
*AMITRAZ	6
*AMITROLE	5
ANTU	5
*AROCLOR 1016 (A PCB)	7
*ARSENIC COMPOUNDS	6
*ARSENIC	6
ASULAM	7
*ATRAZINE	9
AVERMECTIN B1	7
*BENOMYL	1,7
*BENZENE	5
*BENZO(A)PYRENE	14
BIORESMETHRIN	1
BISULFAN	14
BORIC ACID	5
BRADIFACOUM	1
BUSULFAN	3
BUTACHLOR	4
*CADMIUM	14
CAPROLACTAM	7
CAPTAFAL	6
*CAPTAN	7,6
*CARBARYL	6
*CARBOFURAN	6
*CARBON TETRACHLORIDE	1
*CARBON DISULFIDE	5
CARBOPHENOTHION	1
*CHLORDANE	12
CHLORDECONE	1
CHLORDIMEFORM	6
CHLORFENVINPHOS	6
CHLORMEQUAT	5
*CHLOROBENZILATE	7
*CHLOROBIPHENYLS (INCLUDES PCBS)	3

<sup>&</sup>lt;sup>6</sup> Results of genotoxic tests are often mixed because they evaluate different aspects of a chemical's ability to cause genetic damage and impair cell replication.

TABLE III.1-2. CHEMICALS ASSOCIATED WITH GENOTOXIC EFFECTS	
DATA FROM HUMAN, ANIMAL, AND IN VITRO STUDIES ARE INCLUDED.	
CHEMICAL	REFERENCES
*CHLOROFORM	1
CHLOROPHACINONE	1
CHLOROPROPHAM	7
*CHLOROTHALONIL	1
CHLORPROPHONE	1
*CHROMIUM	16
*COPPER SULFATE	5
COUMACHLOR	1
COUMAFURYL	1
COUMATETRALYL	1
*CYANIDES	1
*CYCLOHEXANE	5
CYCLOHEXANONE	5
CYCLOHEXIMIDE	5
CYCLOPENTAPYRENE	2
CYCLOPHOSPHAMIDE	14
*CYHALOTHRIN	7
*2,4-D	6
DALAPON	5
DECAMETHRIN	1
DEET (DIETHYLTOLUAMIDE)	5
DI(2-ETHYL HEXYL) ADIPATE	7
*DIBROMOCHLOROPROPANE	5,6
*DICAMBA	7
DICHLOBENIL	1
*O-DICHLOROBENZENE	1
*P-DICHLOROBENZENE	5
DICHLOROETHYL ETHER	5
1,3-DICHLOROROPENE (2,3 ON TRI)	5
*DICHLORVOS	13
DIETHYLSTILBESTROL (DES)	3
DIFENACOUM	1
*DIMETHOATE	6
DIMETHYL SULFOXIDE	5
DINOSEB	14
*DIOXANE	5
DIPHACINONE	1
DIPHENYLHYDANTOIN	3
DIQUAT	5
DISULFOTON	1
*DIURON	5
ENDRIN	6
*EPICHLOROHYDRIN	5
EPN	1
EPTC	7
ETHANOL	14
*ETHYL BENZENE	· · ·
ETHYLENE DIBROMIDE	8,6
*ETHYLENE DICHLORIDE	5
*ETHYLENE THIOUREA	14
*ETHYLENE OXIDE	5
ETHYLNITROSUREA	3
LITTLINITIOSUNEA	
ELICENIAL	F
EUGENAL *FENBUTATIN OXIDE	5 1

TABLE III.1-2. CHEMICALS ASSOCIATED WITH GENOTOXIC EFFECTS	
DATA FROM HUMAN, ANIMAL, AND IN VITRO STUDIES ARE INCLUDED.	
CHEMICAL	REFERENCES
*FERBAM	1
*FLUOMETURON	6
FLURPRIMIDOL	7
FLUTOLANIL	7
*FOLPET	8
*FORMALDEHYDE	5
GLYCEROL FORMAL	1
GLYPHOSATE	7
HALOXYFOP METHYL	7
*HEXACHLOROBENZENE	5
*HEXACHLOROPHENE	1
*LEAD	14
*LINDANE	1
*LINURON	5
*LITHIUM (TRI LISTED AS LITHIUM CARBONATE)	3
*MALATHION	1
*MALEIC HYDRAZIDE	5
*MANEB	6
*MCPA	1
*MERCURY	7
*MERCURY COMPOUNDS	15
METALDEHYDE	5
METHIDATHION	1
METHIMAZOLE	3
METHOMYL	6
*METHOXYCHLOR	5,7
*METHYL ETHYL KETONE (MEK)	7
METHYL BROMIDE	1
*METHYL METHACRYLATE	5
METHYLCHOLANTHRENE	5 14
METHYLCHOLANTHRENE METHYLENE CHLORIDE	5 14 5
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR	5 14 5 1,7
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE	5 14 5 1,7
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX	5 14 5 1,7 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MNNG	5 14 5 1,7 1 14 3
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MNNG *MOLINATE	5 14 5 1,7 1 14 3
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MNNG *MOLINATE *NABAM	5 14 5 1,7 1 14 3 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES	5 14 5 1,7 1 14 3 1 5
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MINIG *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE	5 14 5 1,7 1 14 3 1 5 1
METHYLENE CHLORIDE  METOLACHLOR  MEXACARBATE  MIREX  MNNG  *MOLINATE  *NABAM  *NAPHTHALENES  NAPROPAMIDE  *NICKEL	5 14 5 1,7 1 14 3 1 5 1 7
METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MINIG *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES	5 14 5 1,7 1 14 3 1 5 1 7
METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MINIG *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE	5 14 5 1,7 1 14 3 1 5 1 7 15
METHYLENE CHLORIDE  METOLACHLOR  MEXACARBATE  MIREX  MING  *MOLINATE  *NABAM  *NAPHTHALENES  NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE  NITRITE	5 14 5 1,7 1 14 3 1 5 1 7 15 1
METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE NITROFEN	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7
METHYLENE CHLORIDE  METOLACHLOR  MEXACARBATE  MIREX  MNNG  *MOLINATE  *NABAM  *NAPHTHALENES  NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE  NITROFEN  NITROGUANIDNE	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7
METHYLENE CHLORIDE  METOLACHLOR  MEXACARBATE  MIREX  MING  *MOLINATE  *NABAM  *NAPHTHALENES  NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE  NITRITE  *NITROFEN  NITROGUANIDINE  *OXYFLUORFEN	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7 6
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING  *MOLINATE  *NABAM  *NAPHTHALENES NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE NITRITE  *NITROFEN NITROGUANIDINE  *OXYFLUORFEN  *PARAQUAT	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7 6 5
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING  *MOLINATE  *NABAM  *NAPHTHALENES NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE NITRITE  *NITROFEN NITROGUANIDINE  *OXYFLUORFEN  *PARAQUAT  *PARATHION	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7 4 7
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING  *MOLINATE  *NABAM  *NAPHTHALENES NAPROPAMIDE  *NICKEL  *NICOTINES  *NITRATE NITRATE NITRITE  *NITROFEN NITROGUANIDINE  *OXYFLUORFEN  *PARAQUAT  *PARATHION  *PCBS	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 6 5 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE NITRATE NITRATE NITROFEN NITROGUANIDINE *OXYFLUORFEN *PARAQUAT *PARATHION *PCBS PENTACHLORONITROBENZENE	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7 4 7 6 5 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE NITRITE *NITROFEN NITROGUANIDINE *OXYFLUORFEN *PARAQUAT *PARATHION *PCBS PENTACHLOROPHENOL	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 4 7 6 5 1 1 1 1 1 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE NITRATE NITRATE NITROFEN NITROGUANIDINE *OXYFLUORFEN *PARAQUAT *PARATHION *PCBS PENTACHLORONITROBENZENE *PENTACHLOROPENOL *PERCHLOROETHYLENE	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 7 4 7 6 5 1
METHYLCHOLANTHRENE METHYLENE CHLORIDE METOLACHLOR MEXACARBATE MIREX MING *MOLINATE *NABAM *NAPHTHALENES NAPROPAMIDE *NICKEL *NICOTINES *NITRATE NITRATE NITRATE NITROFEN NITROGUANIDINE *OXYFLUORFEN *PARAQUAT *PARATHION *PCBS PENTACHLORONITROBENZENE *PENTACHLOROPHENOL	5 14 5 1,7 1 14 3 1 5 1 7 15 1 7 4 7 6 5 1 1 1 1 1 1

TABLE III.1-2. CHEMICALS ASSOCIATED WITH GENOTOXIC EFFECTS	
DATA FROM HUMAN, ANIMAL, AND IN VITRO STUDIES ARE INCLUDED.	
CHEMICAL	REFERENCES
*PHENOL	1,7
*O-PHENYLPHENOL	5
PHOSMET	1
*PICLORAM	1
PIDRIN	7
PINDONE	1
*PIPERONYL BUTOXIDE	1
PIRIMICARB	1
PIRIMIPHOS-ETHYL	1
*PIRIMIPHOS-METHYL	6
2-PIVALYL-1,3 INDANDIONE	1
*PROPACHLOR	4
*PROPARGITE	7
PROPHAM	1
*PROPOXUR	1
*PROPYLENE OXIDE	5
PROPYLENE DICHLORIDE	5
PYRAZON	1
*PYRIDINE	5
RADIONUCLIDES (ALPHA, BETA, & GAMMA EMITTERS)	3
*RESMETHRIN	7
RONNEL	1
ROTENONE	1
SODIUM CHLORATE	5
*STRYCHNINE	5
SULFUR DIOXIDE	5
TCDD	14
2,4,5-T	1
2,4,5-TP	1
*TETRACHLORVINPHOS	1
TETRACYCLINES	3
*THIABENDAZOLE	5
*THIOPHANATE-METHYL 6	6
*THIRAM	1
*TOLUENE	5
*TOXAPHENE	6
*TRICHLORFON	13
*1,2,4-TRICHLOROBENZENE	7
*1,1,1-TRICHLOROETHANE	5
*TRICHLOROETHYLENE	5
TRIDIPHANE	7
*TRIFLURALIN	6
*TRIFORINE	1
TRIMETHADONE	3
*URETHANE	14
VALPROIC ACID	3
VERNAM	7
*WARFARIN	1
*WHITE PHOSPHORUS	3
*XYLENE	5
*ZINEB	5
ZIRAM	1

\* = Listed in TRI. When "compounds" of a metal were listed on TRI, all compounds of that metal in this table are considered to be TRI chemicals.

#### References

- 1. Cunningham and Hallenbeck (1985).
- 2. Archer and Livingston (1983).
- 3. Doull et al. (1980).
- 4. U.S. EPA 1983A).
- 5. U.S. Department of Health and Human Services, NIOSH (1983).
- 6. U.S. EPA (1983B).
- 7. IRIS, EPA online database.
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- 9. Hayes (1982).
- 10. Vettorazzi (1979).
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- 13. Chambers and Yarbrough (1982)
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